



# **Cloud Physics Lidar on Global Hawk**

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# Cloud Physics Lidar on Global Hawk

## Science Applications:

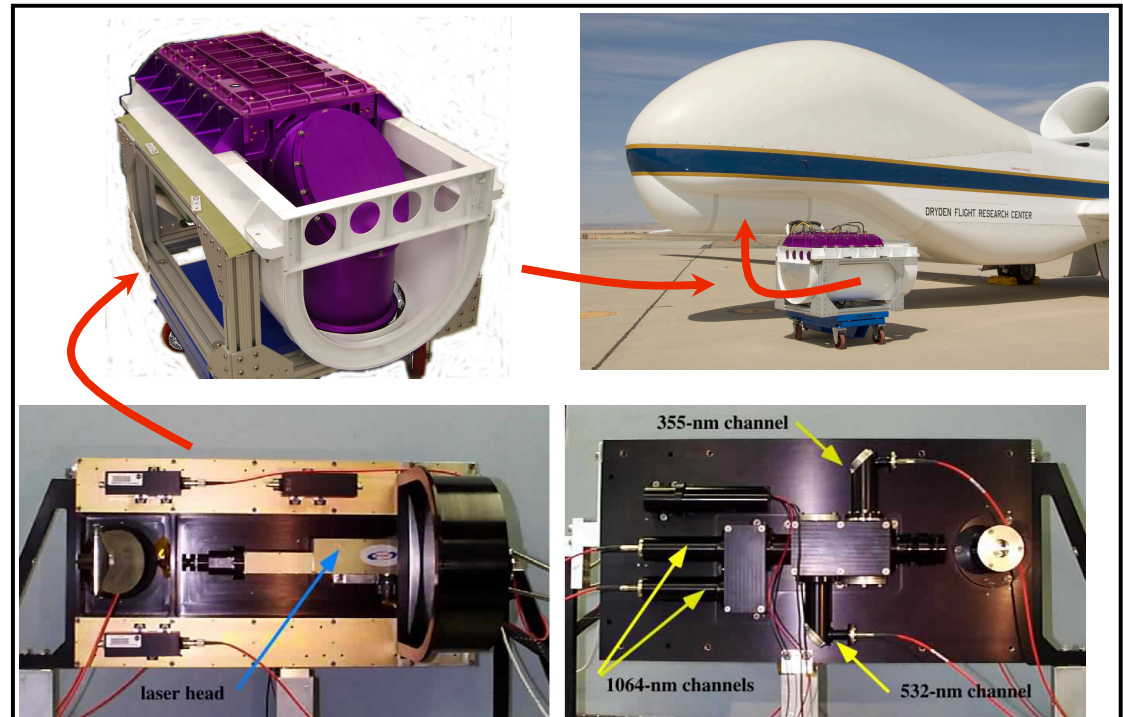
- Cloud and aerosol profiling
- Optical thickness determination
- Smoke and PBL optical properties
- Cloud radiative and optical properties
- Satellite simulation and validation

## Instrument characteristics:

- 355, 532 and 1064 nm channels
- Small field of view eliminates multiple scattering
- Phase discrimination by polarization
- Resolution: 30 m vertical by 200 m horizontal
- Operates from high-altitude Global Hawk or ER-2 platform

More information and data available on the CPL web site:

<http://cpl.gsfc.nasa.gov>



## **CPL Data Products**

- 1. Summary curtain images for each flight.**
- 2. Layer boundaries for PBL, elevated aerosol layers, clouds.**
- 3. Optical properties, including**
  - layer optical depth (e.g., PBL, cirrus, total)**
  - layer extinction-to-backscatter ratio (S) used**
  - layer extinction profile**
  - layer backscatter profile corrected for attenuation**
  - images for extinction and optical depth**
  - depolarization ratio (1064 nm only)**

**All data products are 1 second averages (200 m horiz. X 30 m vertical) produced from the raw 1/10 second data.**

**All data products are produced for each wavelength.**

**Real-time data downlink via Iridium (slow, minutes between updates) or via KU band downlink (fast, can send 532 nm raw profiles each second), can do real-time visualization and project to GHOC screen.**

# CPL ATTREX Payload

## Instrument specifications:

### Mechanical and Electrical

**Size:** instrument: 40"H x 16"W x 18"D  
power supply: 18"H x 19"W x 8"D  
data system: 17"H x 19"W x 6"D

**Weight:** instrument, 265 lbs (carrier assembly ~45 lbs);  
power supply, 67 lbs;  
data system/cables, 34 lbs. Total: 376 lbs

**Power:** laser ~10 Amps 28VDC;  
heaters ~35 Amps 28VDC;  
data system ~2 Amps 110 VAC 400 Hz.

**Inlet probe:** n/a

**Exhaust port:** n/a

**View ports/windows:** 9" dia. nadir-viewing port (window supplied as part of instrument)

**Hazards:** Laser, Nd:YVO4 (1064, 532, 355 nm)

## Instrument Requirements:

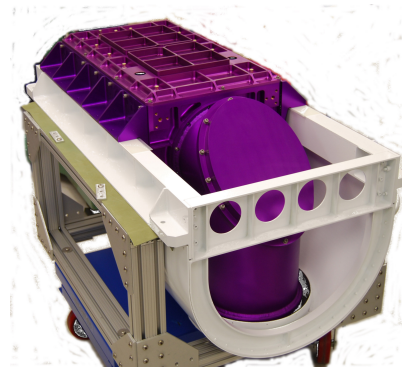
### Control and Communication

**# Control Switches:** 2 (master power, laser enable)

**Communication Bandwidth:** as much as possible, but we can sub-sample as needed.

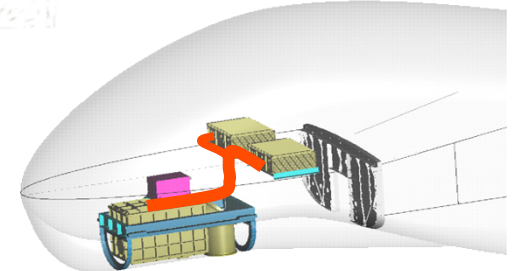
**Nav / Time inputs:** yes

## Instrument Photo:



UAV-CPL instrument housing, similar to ER-2 CPL, but with turning mirror extension added.

Schematic of UAV-CPL installation in Global Hawk bay "3".



## Instrument Modifications:

None planned at this time.



## CPL for Global Hawk

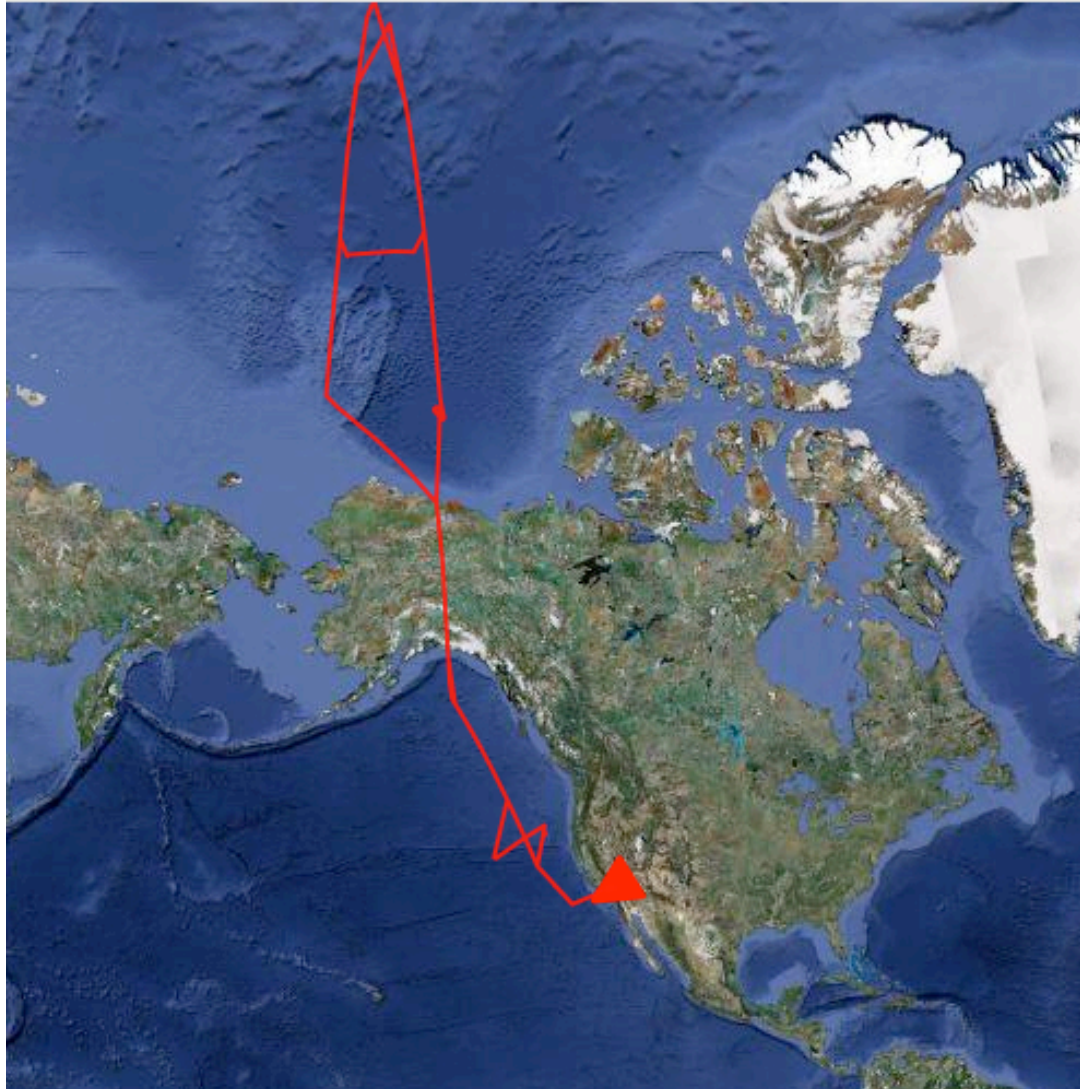




## CPL for Global Hawk



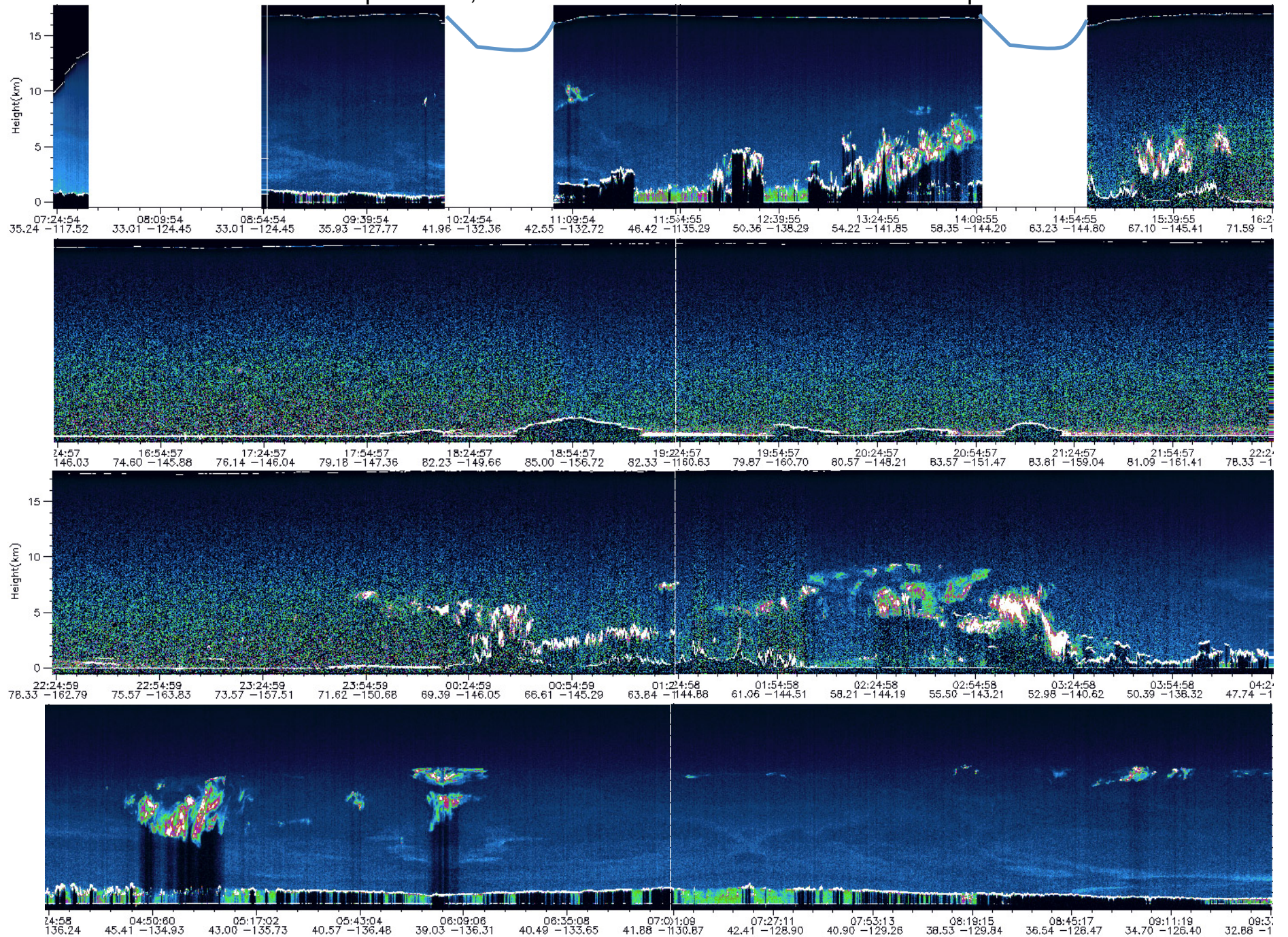
## GloPac 3<sup>rd</sup> Science Flight, April 23-24



Objective: fly to 85N, sample polar vortex, sample Asian dust.

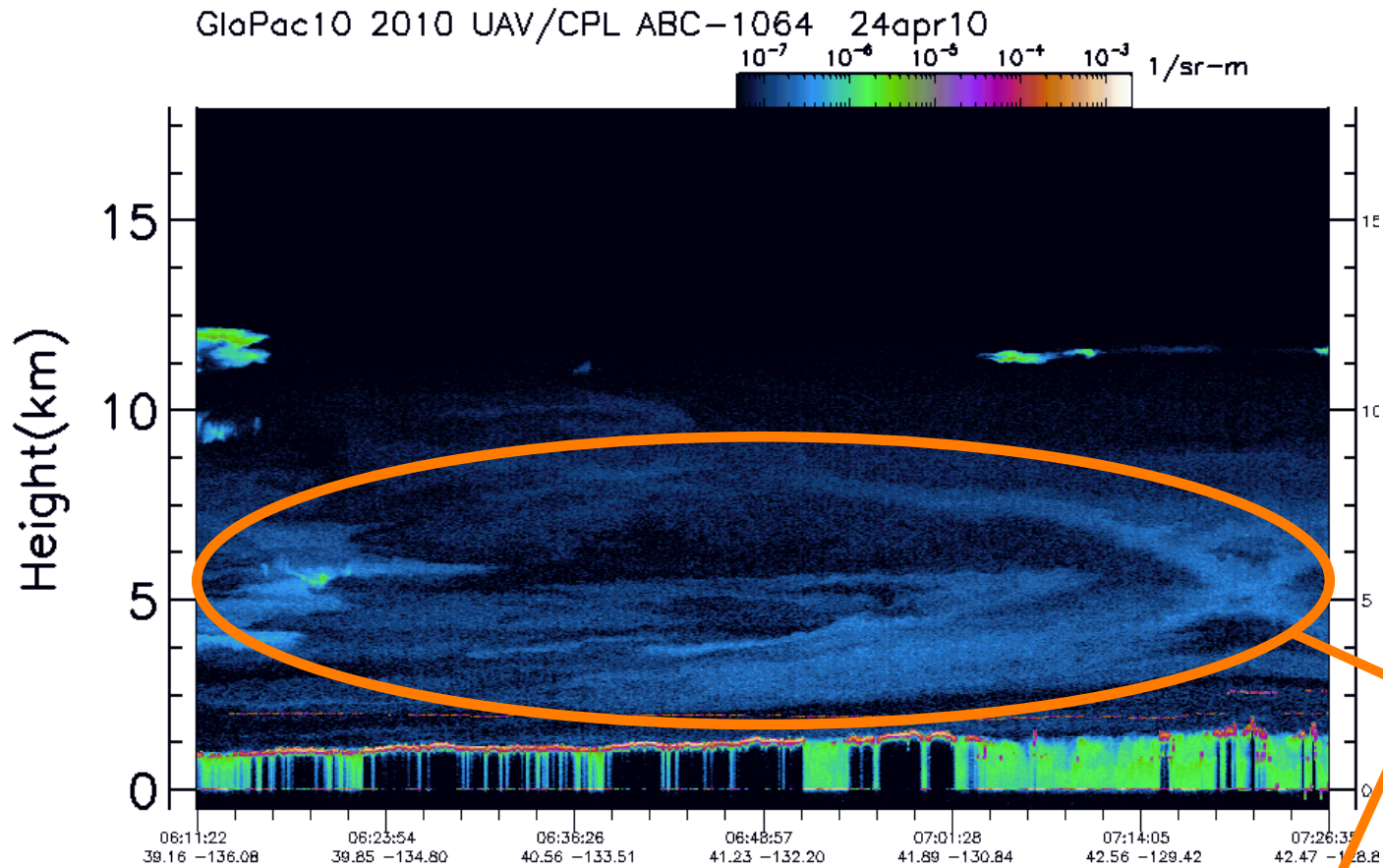


April 23-24, 2010: CPL 532 nm attenuated backscatter profiles





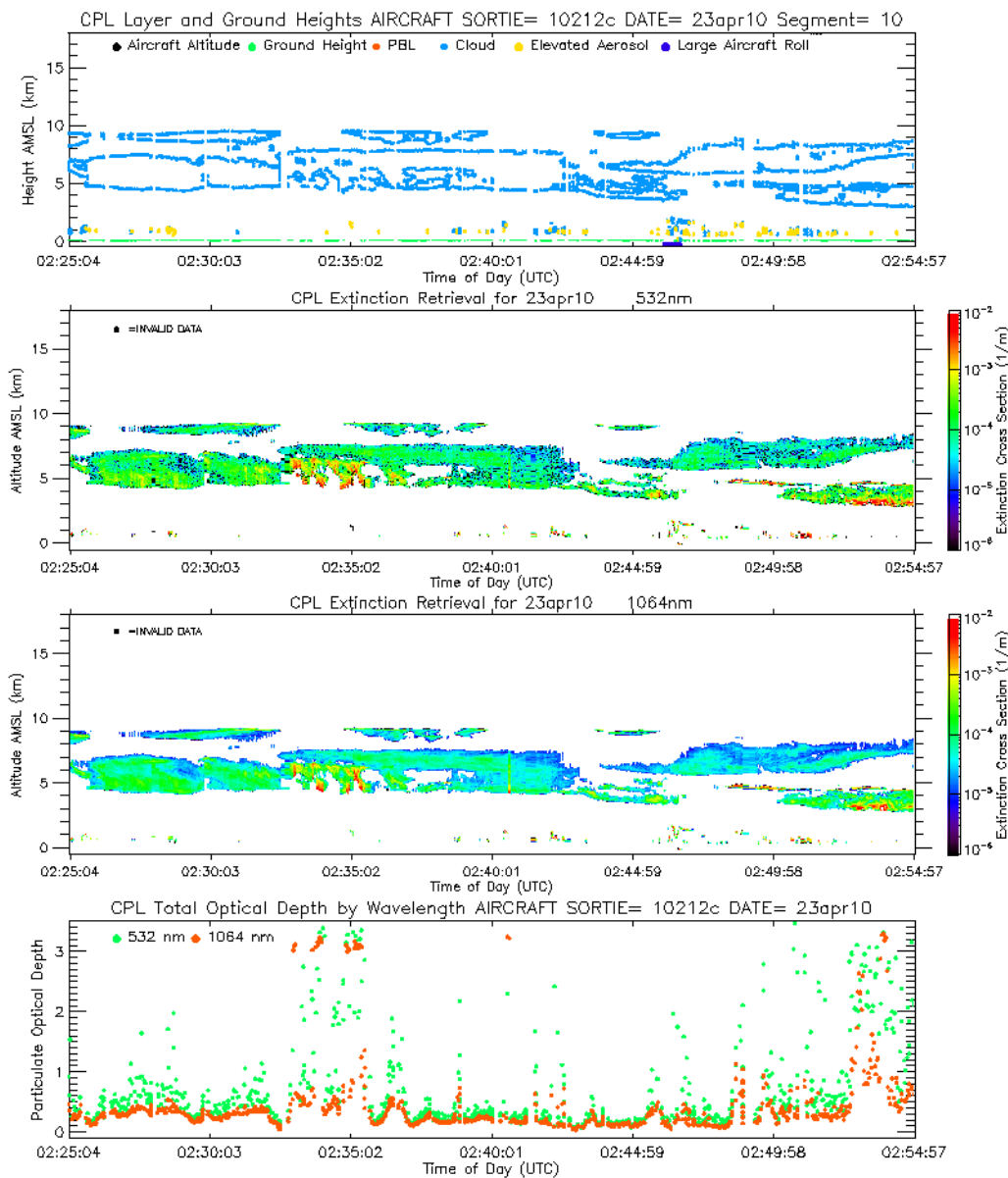
## April 24, 2010, 1064 nm profiles



GEOS-5 model prediction of dust optical depth is  $\sim 0.04$  in this region

Average CPL-derived dust optical depth is 0.04

# April 24, 2010, layer location and extinction





## Issues to resolve for ATTREX

Obtaining reasonable accommodation of laser operation was a problem during GloPac, particularly with Dryden range safety. Fratello is well aware, and this needs to be worked aggressively well in advance. We ended up subject to nonsensical rules that cost dearly in terms of test flights. CPL on ER-2 has never been subject to such rules, but GH management allows Crew Chief to make such determinations – needs to be Mission Manager.

Descent maneuvers were troublesome for CPL, requiring an entire hour off (messes with thermal stability, calibration, etc.) just to obtain 15 minutes of lower-altitude in situ sampling. This can be mitigated by intelligent laser safety discussions with FAA (we're out over ocean, after all, so not much eye safety concern!).

Current ATTREX payload has CPL in Zone 25. Would like to move back to Zone 3 where we are already accommodated (with boxes in Zone 25). How quickly can we get confirmation that this is do-able? Otherwise, we have to start assessing mechanical/thermal integration for other locations. Note: CPL goes in Zone 3 for HS3, so maintaining a common mounting location seems optimal for integration purposes.